

WHAT IS CLAIMED IS:

1. A method for producing a crosslinked polymeric article comprising polymerizing a polycycloolefin monomer composition in contact with an addition polymerization catalyst in a mold having the shape of the article, wherein said catalyst comprises a cation complex containing a Group 10 transition metal and weakly coordinating anion complex, and wherein said monomer composition comprises a polycycloolefin monomer containing one polymerizable norbornene-type moiety and a multifunctional polycycloolefin monomer containing at least two polymerizable norbornene-type moieties.

2. A method of making a polymeric article by the in-mold addition polymerization of a polycycloolefin monomer composition comprising:

(a) combining a plurality of reactant streams to form a reaction mixture, at least one of said streams comprises a Group 10 transition metal procatalyst, and another of said reactant streams comprises an activator salt comprising cation and a weakly coordinating anion, wherein said cation is selected from the group consisting of a Group 1 element cation, a Group 2 metal cation, and a transition metal cation selected from the group consisting of zinc, silver, and thallium, and at least one of said streams containing a polycycloolefin monomer containing one polymerizable norbornene-type moiety; and

(b) injecting said reaction mixture into a mold where polymerization occurs, forming a polymeric article in the shape of the mold.

3. The method of claim 2 wherein said polycycloolefin monomer composition includes a multifunctional polycycloolefin.

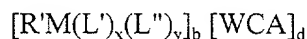
4. The method of claim 1 or 3 wherein said polycycloolefin monomer composition comprises from 0.25 to 99.75 mole % of a multifunctional polycycloolefinic monomer.

5. The method of claim 1 or 3 wherein said multifunctional polycycloolefin has a carbon to double bond ratio of from about 3.0 to about 17.

6. The method of claim 2 wherein said Group 1 element in said cation is selected from the group consisting of proton, lithium, sodium, and potassium.

7. The method of claim 2 wherein said Group 2 metal in said cation is selected from the group consisting of magnesium, calcium, strontium, and barium.

8. The method of claim 1 wherein said catalyst is selected from a compound of the formula:



wherein M represents a Group 10 transition metal; R' represents an anionic hydrocarbyl ligand; L' represents a Group 15 neutral electron donor ligand; L'' represents a labile neutral electron donor ligand; x is 1 or 2; y is 0, 1, or 2; WCA represents a weakly coordinating counteranion complex; and b and d are numbers representing the number of times the cation complex and weakly coordinating counter anion complex are taken to balance the electronic charge of the overall catalyst complex.

9. The method of claim 2 wherein said Group 10 transition metal procatalyst is selected from a compound of the formula:



wherein M represents a Group 10 transition metal; R' represents an anionic hydrocarbyl ligand; L' represents a Group 15 neutral electron donor ligand; A' is an anionic leaving group; x is 1 or 2.

10. The method of claim 2 wherein at least one of said reactant streams contains a Group 15 electron donor ligand compound and said Group 10 transition metal procatalyst is selected from a compound of the formula:

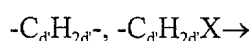


wherein M represents a Group 10 transition metal; R' represents an allylic ligand; L' represents a Group 15 neutral electron donor ligand; A' is an ionic leaving group.

11. The method of claim 8, 9, or 10 wherein M is selected from the group consisting of nickel, palladium, and platinum.

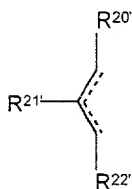
12. The method of claim 8 or 9 wherein R' is selected from the group consisting of hydrogen; linear and branched C₁-C₂₀ alkyl; linear and branched C₂-C₂₀ alkenyl; allylic ligands and canonical forms thereof; substituted and unsubstituted C₅-C₁₀ cycloalkyl; substituted and unsubstituted C₆-C₁₅ cycloalkenyl; substituted and unsubstituted C₇-C₃₀ aralkyl; substituted and unsubstituted, C₆-C₃₀ aryl; C₅-C₃₀ heteroatom containing aryl; wherein said heteroatom is selected from the group consisting of sulfur, oxygen, nitrogen, phosphorus, wherein the

substituents in said substituted radicals are selected from the group consisting of linear or branched C₁-C₅ alkyl, linear or branched C₁-C₅ haloalkyl, linear or branched C₂-C₅ alkenyl, haloalkenyl, halogen, and phenyl optionally substituted with linear or branched C₁-C₅ alkyl, linear or branched C₁-C₅ haloalkyl, and halogen; and a hydrocarbyl containing ligand selected from the formulae:



each of said ligands together with the Group 10 metal form a metallacycle or heteroatom containing metallacycle, wherein d' represents an integer from 3 to 10, and X→ represents an alkenyl or heteroatom containing moiety that coordinates to the Group 10 metal center.

13. The method of claim 12 wherein said allylic ligand is represented by the formula:

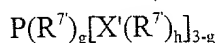


wherein R^{20'}, R^{21'}, and R^{22'} each independently represent hydrogen, halogen, linear and branched C₁-C₅ alkyl, C₅-C₁₀ cycloalkyl, linear and branched C₁-C₅ alkenyl, C₆-C₃₀ aryl, and C₇-C₃₀ aralkyl, each of the foregoing radicals optionally substituted with a substituent selected from linear and branched C₁-C₅ alkyl, linear and branched C₁-C₅ haloalkyl, halogen, and phenyl which can optionally be substituted with linear and branched C₁-C₅ alkyl, linear and branched C₁-C₅ haloalkyl, and halogen; any two of R^{20'}, R^{21'}, and R^{22'} can be linked together with the carbon atoms to which they are attached to form a cyclic or multicyclic ring, each

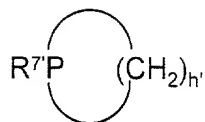
optionally substituted with linear or branched C₁-C₅ alkyl, linear or branched C₁-C₅ haloalkyl, and halogen.

14. The method of claim 8, 9, or 10 wherein said group
15 electron donor ligand is selected from the group consisting of amines, pyridines, arsines, stibines and organophosphorus containing compounds.

15. The method of claim 14 wherein said organophosphorus
containing ligand is selected from a compound of the formula:



wherein X' is oxygen, sulfur, nitrogen, or silicon; g is 0, 1, 2, or 3; h is 1, 2, or 3, with the proviso that when X' is a silicon atom, h is 3, when X' is an oxygen or sulfur atom h is 1, and when X' is a nitrogen atom, h is 2; R⁷ is independently selected from hydrogen, linear and branched C₁-C₁₀ alkyl, C₅-C₁₀ cycloalkyl, linear and branched C₁-C₁₀ alkoxy, allyl, linear and branched C₂-C₁₀ alkenyl, C₆-C₁₂ aryl, C₆-C₁₂ aryloxy, C₆-C₁₂ arylsulfides, C₇-C₁₈ aralkyl, cyclic ethers and thioethers, tri(linear and branched C₁-C₁₀ alkyl)silyl, tri(C₆-C₁₂ aryl)silyl, tri(linear and branched C₁-C₁₀ alkoxy)silyl, triaryloxysilyl, tri(linear and branched C₁-C₁₀ alkyl)siloxy, and tri(C₆-C₁₂ aryl)siloxy, wherein each of the foregoing substituents can be optionally substituted with linear or branched C₁-C₅ alkyl, linear or branched C₁-C₅ haloalkyl, C₁-C₅ alkoxy, halogen, and combinations thereof; when g is 0 and X' is oxygen, any two or 3 of R⁷ can be taken together with the oxygen atoms to which they are attached to form a cyclic moiety; when g is 3 any two of R⁷ can be taken together with the phosphorus atom to which they are attached to represent a phosphacycle of the formula:



wherein R^r is as previously defined and h' is an integer from 4 to 11.

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16. The method of claim 15 wherein g is 3 and R^r is independently selected from the group consisting of hydrogen, linear and branched C₁-C₁₀ alkyl, C₅-C₁₀ cycloalkyl, linear and branched C₁-C₁₀ alkoxy, allyl, linear and branched C₂-C₁₀ alkenyl, C₆-C₁₂ aryl, and C₆-C₁₂ aryloxy.

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17. The method of claim 15 wherein said organophosphorus containing ligand is a phosphine selected from the group consisting of trimethylphosphine, triethylphosphine, tri-*n*-propylphosphine, triisopropylphosphine, tri-*n*-butylphosphine, tri-*sec*-butylphosphine, tri-*i*-butylphosphine, tri-*t*-butylphosphine, tricyclopentylphosphine, triallylphosphine, tricyclohexylphosphine, triphenylphosphine, trinaphthylphosphine, tri-*p*-tolylphosphine, tri-*o*-tolylphosphine, tri-*m*-tolylphosphine, tribenzylphosphine, tri(*p*-trifluoromethylphenyl)phosphine, tris(trifluoromethyl)phosphine, tri(*p*-fluorophenyl)phosphine, tri(*p*-trifluoromethylphenyl)phosphine, allyldiphenylphosphine, benzyldiphenylphosphine, bis(2-furyl)phosphine, bis(4-methoxyphenyl)phenylphosphine, bis(4-methylphenyl)phosphine, bis(3,5-bis(trifluoromethyl)phenyl)phosphine, *t*-butylbis(trimethylsilyl)phosphine, *t*-butyldiphenylphosphine, cyclohexyldiphenylphosphine, diallylphenylphosphine, dibenzylphosphine, dibutylphenylphosphine, dibutylphosphine,

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di-*t*-butylphosphine, dicyclohexylphosphine, diethylphenylphosphine,
di-*i*-butylphosphine, dimethylphenylphosphine,
dimethyl(trimethylsilyl)phosphine, diphenylphosphine,
diphenylpropylphosphine, diphenyl(*p*-tolyl)phosphine,
5 diphenyl(trimethylsilyl)phosphine, diphenylvinylphosphine,
divinylphenylphosphine, ethyldiphenylphosphine,
(2-methoxyphenyl)methylphenylphosphine, tri-*n*-octylphosphine,
tris(3,5-bis(trifluoromethyl)phenyl)phosphine,
tris(3-chlorophenyl)phosphine, tris(4-chlorophenyl)phosphine,
10 tris(2,6-dimethoxyphenyl)phosphine, tris(3-fluorophenyl)phosphine,
tris(2-furyl)phosphine, tris(2-methoxyphenyl)phosphine,
tris(3-methoxyphenyl)phosphine, tris(4-methoxyphenyl)phosphine,
tris(3-methoxypropyl)phosphine, tris(2-thienyl)phosphine,
tris(2,4,6-trimethylphenyl)phosphine, tris(trimethylsilyl)phosphine,
15 isopropyldiphenylphosphine, dicyclohexylphenylphosphine,
(+)-neomenthyldiphenylphosphine, tribenzylphosphine,
diphenyl(2-methoxyphenyl)phosphine,
diphenyl(pentafluorophenyl)phosphine,
bis(pentafluorophenyl)phenylphosphine, and
20 tris(pentafluorophenyl)phosphine.

18. The method of claim 8 wherein said labile neutral electron
donor ligand is selected from the group consisting of DMF, DMSO,
cyclooctadiene, water, chlorinated alkanes, alcohols, ethers, ketones,
25 nitriles, arenes, phosphine oxides, organic carbonates and esters.

19. The method of claim 9 or 10 wherein said anionic leaving
group is selected from the group consisting of halogen, nitrate, triflate,
triflimide trifluoroacetate, tosylate, AlBr_4^- , AlF_4^- , AlCl_4^- , $\text{AlF}_3\text{O}_3\text{SCF}_3^-$,
30 AsCl_6^- , SbCl_6^- , SbF_6^- , PF_6^- , BF_4^- , ClO_4^- , HSO_4^- , carboxylates, acetates,

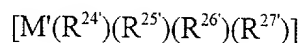
acetylacetonates, carbonates, aluminates, borates, hydrocarbyl and halogenated hydrocarbyl selected from hydride, linear and branched C₁-C₅ alkyl, linear and branched C₁-C₅ haloalkyl, C₅-C₁₀ cycloalkyl, C₅-C₁₀ cyclohaloalkyl, C₆-C₁₀ aryl, and C₆-C₁₀ haloaryl, wherein said
5 cyclohaloalkyl and haloaryl groups are monosubstituted or multisubstituted with a halogen group selected from bromine, chlorine, fluorine, and iodine.

20. The method of claim 2, 9, or 19 wherein said procatalyst is
10 selected from a compound of group consisting of
bis(triisopropylphosphine)(hydrido)palladium chloride,
bis(triisopropylphosphine)(hydrido)palladium nitrate,
bis(triisopropylphosphine)(hydrido)palladium triflate,
(allyl)palladium(triisopropylphosphine) chloride,
15 (methallyl)palladium(triisopropylphosphine) chloride,
(crotyl)palladium(triisopropylphosphine) chloride,
(allyl)palladium(triisopropylphosphine) trifluoroacetate,
(1,1-dimethyl- π -allyl(triisopropylphosphine)palladium trifluoroacetate,
(2-chloroallyl)palladium(triisopropylphosphine) trifluoroacetate,
20 (allyl)palladium(triisopropylphosphine) triflate,
(crotyl)palladium(triisopropylphosphine) triflate,
(methallyl)palladium(triisopropylphosphine) triflate,
(allyl)palladium(triisopropylphosphine) triflimide,
(methallyl)palladium(triisopropylphosphine) triflimide,
25 bis(tricyclohexylphosphine)(hydrido)palladium chloride,
bis(tricyclohexylphosphine)(hydrido)palladium nitrate,
bis(tricyclohexylphosphine)(hydrido)palladium trifluoroacetate,
bis(tricyclohexylphosphine)(hydrido)palladium formate,
(allyl)palladium(tricyclohexylphosphine) chloride,
30 (methallyl)palladium(tricyclohexylphosphine) chloride,

(allyl)palladium(tricyclohexylphosphine) trifluoroacetate,
(allyl)palladium(tricyclohexylphosphine) triflate,
(methallyl)palladium(tricyclohexylphosphine) triflate,
(crotyl)palladium(tricyclohexylphosphine) triflate,
5 (methallyl)palladium(tricyclohexylphosphine) triflimide,
(allyl)palladium(tricyclohexylphosphine) *p*-tolylsulfonate,
(allyl)palladium(tricyclohexylphosphine) triflimide,
(allyl)palladium(tricyclopentylphosphine)chloride,
(methallyl)palladium(tricyclopentylphosphine) chloride,
10 (allyl)palladium(tricyclopentylphosphine) triflate,
(crotyl)palladium(tricyclopentylphosphine) triflate,
(methallyl)palladium(tricyclopentylphosphine) triflate,
(allyl)palladium(tricyclopentylphosphine) triflimide,
(methallyl)palladium(tricyclopentylphosphine)triflimide,
15 (allyl)palladium(triisopropylphosphine)C₆F₅,
(allyl)palladium(tricyclohexylphosphine)C₆F₅, and
[(allyl)palladium(HOCH₃)(triisopropylphosphine)][B(O₂-3,4,5,6-Cl₄C₆)₂].

21. The method of claim 3, 8, 9, or 10 wherein said weakly
20 coordinating anion is selected from the group consisting of borates,
aluminates, boratobenzene anions, carborane anions, and halocarborane
anions.

22. The process of claim 21 wherein the weakly coordinating
25 anion is a borate or aluminate of the formula:



wherein M' is boron or aluminum and R^{24'}, R^{25'}, R^{26'}, and R^{27'}
30 independently represent fluorine, linear and branched C₁-C₁₀ alkyl, linear

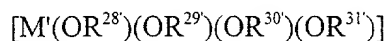
and branched C₁-C₁₀ alkoxy, linear and branched C₃-C₅ haloalkenyl, linear and branched C₃-C₁₂ trialkylsiloxy, C₁₈-C₃₆ triarylsiloxy, substituted and unsubstituted C₆-C₃₀ aryl, and substituted and unsubstituted C₆-C₃₀ aryloxy groups, wherein R^{24'} to R^{27'} can not simultaneously represent alkoxy or simultaneously represent aryloxy, and wherein said aryl and aryloxy groups when substituted are monosubstituted or multisubstituted and said substituents are independently selected from linear and branched C₁-C₅ alkyl, linear and branched C₁-C₅ haloalkyl, linear and branched C₁-C₅ alkoxy, linear and branched C₁-C₅ haloalkoxy, linear and branched C₁-C₁₂ trialkylsilyl, C₆-C₁₈ triarylsilyl, and halogen selected from chlorine, bromine, and fluorine.

23. The process of claim 22 wherein said borate is selected from the group consisting of tetrakis(pentafluorophenyl)borate, tetrakis(3,5-bis(trifluoromethyl)phenyl)borate, tetrakis(2-fluorophenyl)borate, tetrakis(3-fluorophenyl)borate, tetrakis(4-fluorophenyl)borate, tetrakis(3,5-difluorophenyl)borate, tetrakis(2,3,4,5-tetrafluorophenyl)borate, tetrakis(3,4,5,6-tetrafluorophenyl)borate, tetrakis(3,4,5-trifluorophenyl)borate, methyltris(perfluorophenyl)borate, ethyltris(perfluorophenyl)borate, phenyltris(perfluorophenyl)borate, tetrakis(1,2,2-trifluoroethylenyl)borate, tetrakis(4-tri-*i*-propylsilyltetrafluorophenyl)borate, tetrakis(4-dimethyl-*tert*-butylsilyltetrafluorophenyl)borate, (triphenylsiloxy)tris(pentafluorophenyl)borate, (octyloxy)tris(pentafluorophenyl)borate, tetrakis[3,5-bis[1-methoxy-2,2,2-trifluoro-1-(trifluoromethyl)ethyl]phenyl]borate, tetrakis[3-[1-methoxy-2,2,2-trifluoro-1-(trifluoromethyl)ethyl]-5-(trifluoromethyl)phenyl]borate, and tetrakis[3-[2,2,2-trifluoro-1-(2,2,2-

trifluoroethoxy)-1-(trifluoromethyl)ethyl]-5-(trifluoromethyl)phenyl]borate.

24. The process of claim 22 wherein said aluminate is selected from the group consisting of tetrakis(pentafluorophenyl)aluminate, tris(nonafluorobiphenyl)fluoroaluminate, (octyloxy)tris(pentafluorophenyl)aluminate, tetrakis(3,5-bis(trifluoromethyl)phenyl)aluminate, and methyltris(pentafluorophenyl)aluminate.

25. The process of claim 21 wherein the weakly coordinating anion is a borate or aluminate of the formula:



M' is boron or aluminum, R²⁸, R²⁹, R³⁰, and R³¹ independently represent linear and branched C₁-C₁₀ alkyl, linear and branched C₁-C₁₀ haloalkyl, C₂-C₁₀ haloalkenyl, substituted and unsubstituted C₆-C₃₀ aryl, and substituted and unsubstituted C₇-C₃₀ aralkyl groups, subject to the proviso that at least three of R²⁸ to R³¹ must contain a halogen containing substituent; OR²⁸ and OR²⁹ can be taken together to form a chelating substituent represented by -O-R³²-O-, wherein the oxygen atoms are bonded to M' and R³² is a divalent radical selected from substituted and unsubstituted C₆-C₃₀ aryl and substituted and unsubstituted C₇-C₃₀ aralkyl, wherein said aryl and aralkyl groups when substituted are monosubstituted or multisubstituted and said substituents are independently selected from linear and branched C₁-C₅ alkyl, linear and branched C₁-C₅ haloalkyl, linear and branched C₁-C₅ alkoxy, linear and branched C₁-C₅ haloalkoxy, linear and branched C₁-C₁₂ trialkylsilyl,

C₆-C₁₈ triarylsilyl, and halogen selected from chlorine, bromine, and fluorine.

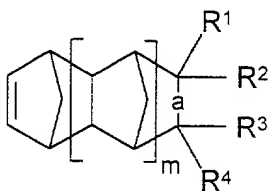
26. The process of claim 25 wherein said borate is selected
5 from the group consisting of [B(O₂C₆F₄)₂]⁻, [B(OC(CF₃)₂(CH₃))₄]⁻,
[B(OC(CF₃)₂H)₄]⁻, [B(OC(CF₃)(CH₃)H)₄]⁻, and [B(OCH₂(CF₃))₄]⁻.

27 The process of claim 25 wherein said aluminate is selected
from the group consisting of , [Al(OC(CF₃)₂Ph)₄]⁻, [Al(OC(CF₃)₂C₆H₄-4-
10 CH₃)₄]⁻, [Al(OC(CF₃)₃)₄]⁻, [Al(OC(CF₃)(CH₃)H)₄]⁻, [Al(OC(CF₃)₂H)₄]⁻,
[Al(OC(CF₃)₂C₆H₄-4-*i*-Pr)₄]⁻, [Al(OC(CF₃)₂C₆H₄-4-*t*-butyl)₄]⁻,
[Al(OC(CF₃)₂C₆H₄-4-SiMe₃)₄]⁻, [Al(OC(CF₃)₂C₆H₄-4-Si-*i*-Pr₃)₄]⁻,
[Al(OC(CF₃)₂C₆H₂-2,6-(CF₃)₂-4-Si-*i*-Pr₃)₄]⁻,
[Al(OC(CF₃)₂C₆H₃-3,5-(CF₃)₂)₄]⁻, [Al(OC(CF₃)₂C₆H₂-2,4,6-(CF₃)₃)₄]⁻, and
15 [Al(OC(CF₃)₂C₆F₅)₄]⁻.

28. The process of claim 2, 9, or 10 wherein said activator salt
is selected from the group consisting of
lithium tetrakis(pentafluorophenyl)borate,
20 sodium tetrakis(pentafluorophenyl)borate,
lithium(diethyl ether) tetrakis(pentafluorophenyl)borate,
lithium(diethyl ether)₂ tetrakis(pentafluorophenyl)borate,
lithium tris(isopropanol) tetrakis(pentafluorophenyl)borate,
lithium tetrakis(methanol) tetrakis(pentafluorophenyl)borate,
25 silver tetrakis(pentafluorophenyl)borate,
tris(toluene)silver tetrakis(pentafluorophenyl)borate,
trityl tetrakis(pentafluorophenyl)borate,
N,N-dimethylanilinium tetrakis(pentafluorophenyl)borate,
lithium tetrakis(3,5-bis(trifluoromethyl)phenyl)borate,
30 sodium tetrakis(3,5-bis(trifluoromethyl)phenyl)borate,

N,N-dimethylanilinium tetrakis[3,5-bis(trifluoromethyl)phenyl]borate,
 silver tetrakis[3,5-bis(trifluoromethyl)phenyl]borate,
 tris(toluene)silver tetrakis[3,5-bis(trifluoromethyl)phenyl]borate,
 thallium tetrakis[3,5-bis(trifluoromethyl)phenyl]borate, $\text{LiB}(\text{O}_2\text{C}_6\text{F}_4)_2$,
 5 $\text{LiB}(\text{OC}(\text{CH}_3)(\text{CF}_3)_2)_4$, $\text{LiAl}(\text{OC}(\text{CF}_3)_2\text{Ph})_4$, $\text{LiAl}(\text{OC}(\text{CF}_3)_2\text{C}_6\text{H}_4\text{CH}_3)_4$,
 $\text{LiAl}(\text{OC}(\text{CH}_3)(\text{CF}_3)_2)_4$, $\text{LiAl}(\text{OC}(\text{CF}_3)_3)_4$, $\text{LiAl}(\text{OC}(\text{CF}_3)_2\text{C}_6\text{H}_4\text{-4-}i\text{-Pr})_4$,
 $\text{LiAl}(\text{OC}(\text{CF}_3)_2\text{C}_6\text{H}_3\text{-3,5-(CF}_3)_2)_4$, $\text{LiAl}(\text{OC}(\text{CF}_3)_2\text{C}_6\text{H}_2\text{-2,4,6-(CF}_3)_3)_4$, and
 $\text{LiAl}(\text{OC}(\text{CF}_3)_2\text{C}_6\text{F}_5)_4$.

- 10 29. The process of claim 1, 2, 3, 8, 9, or 10 wherein said polycycloolefin monomer composition includes a monomer selected from a compound of the formula:

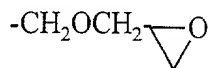


- 15 wherein "a" represents a single or double bond; m is an integer from 0 to 5; when "a" is a double bond one of R^1 , R^2 and one of R^3 , R^4 is not present; and R^1 to R^4 independently represent hydrogen, substituted and unsubstituted linear and branched $\text{C}_1\text{-C}_{10}$ alkyl, linear and branched $\text{C}_1\text{-C}_{10}$ haloalkyl, substituted and unsubstituted linear and branched $\text{C}_2\text{-C}_{10}$ alkenyl, linear and branched $\text{C}_2\text{-C}_{10}$ haloalkenyl, substituted and
 20 unsubstituted linear and branched $\text{C}_2\text{-C}_{10}$ alkynyl, substituted and unsubstituted $\text{C}_4\text{-C}_{12}$ cycloalkyl, substituted and unsubstituted $\text{C}_4\text{-C}_{12}$ halocycloalkyl, substituted and unsubstituted $\text{C}_4\text{-C}_{12}$ cycloalkenyl, substituted and unsubstituted $\text{C}_4\text{-C}_{12}$ halocycloalkenyl, substituted and unsubstituted $\text{C}_6\text{-C}_{12}$ aryl, substituted and unsubstituted $\text{C}_6\text{-C}_{12}$ haloaryl
 25 and substituted and unsubstituted $\text{C}_7\text{-C}_{24}$ aralkyl, R^1 and R^2 or R^3 and R^4

can be taken together to represent a C₁-C₁₀ alkylidenyl group,

-(CH₂)_nC(O)NH₂, -(CH₂)_nC(O)Cl, -(CH₂)_nC(O)OR⁵, -(CH₂)_n-OR⁵,
 -(CH₂)_n-OC(O)R⁵, -(CH₂)_n-C(O)R⁵, -(CH₂)_n-OC(O)OR⁵, -(CH₂)_nSiR⁵,
 -(CH₂)_nSi(OR⁵)₃, -(CH₂)_nC(O)OR⁶, and the group:

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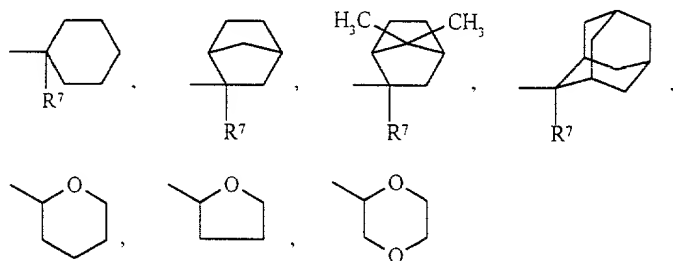
wherein n independently represents an integer from 0 to 10 and R⁵

independently represents hydrogen, linear and branched C₁-C₁₀ alkyl,

linear and branched, C₂-C₁₀ alkenyl, linear and branched C₂-C₁₀ alkynyl,

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C₅-C₁₂ cycloalkyl, C₆-C₁₄ aryl, and C₇-C₂₄ aralkyl; R⁶ represents a radical
 selected from -C(CH₃)₃, -Si(CH₃)₃, -CH(R⁷)OCH₂CH₃, -CH(R⁷)OC(CH₃)₃,
 dicyclopropylmethyl, dimethylcyclopropylmethyl, or the following cyclic
 groups:



15

wherein R⁷ represents hydrogen or a linear or branched (C₁-C₅) alkyl

group; R¹ and R⁴ together with the two ring carbon atoms to which they
 are attached can represent a substituted or unsubstituted cycloaliphatic

group containing 4 to 30 ring carbon atoms, a substituted or unsubstituted

20

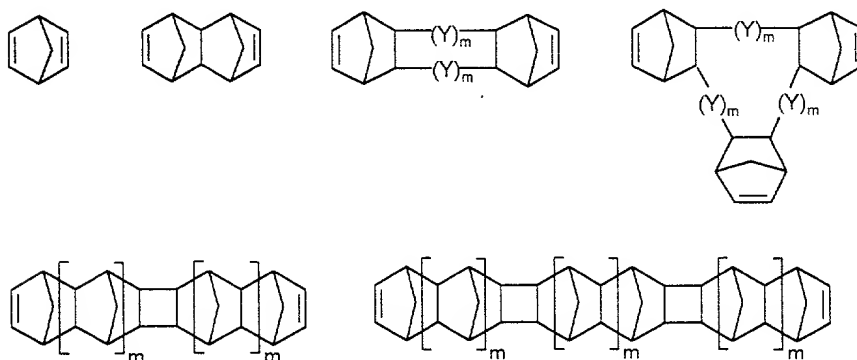
aryl group containing 6 to 18 ring carbon atoms and combinations thereof;

R¹ and R⁴ can be taken together to form the divalent bridging group,

-C(O)-Q-(O)C-, which when taken together with the two ring carbon

atoms to which they are attached form a pentacyclic ring, wherein Q represents an oxygen atom or the group $N(R^8)$, wherein R^8 is selected from hydrogen, halogen, linear and branched C_1 - C_{10} alkyl, and C_6 - C_{18} aryl.

30. The process of claim 29 wherein said polycycloolefin composition includes a multifunctional polycycloolefin monomer selected from the formulae:



and mixtures thereof, wherein Y represents a $(-CH_2-)$ group and m independently represents an integer from 0 to 5, and when m is 0, Y represents a single bond.

31. The process of claim 1, 2, 3, 8, 9, or 10 wherein said reaction mixture further comprises a rate moderator selected from the group consisting of water, tetrahydrofuran, 2-methyltetrahydrofuran, diethyl ether, methyl-*tert*-butyl ether, dimethoxyethane, diglyme, trimethylphosphine, triethylphosphine, tributylphosphine, tri(ortho-tolyl)phosphine, tri-*tert*-butylphosphine, tricyclopentylphosphine, tricyclohexylphosphine, triisopropylphosphine, trioctylphosphine, triphenylphosphine, tri(pentafluorophenyl)phosphine, methyldiphenylphosphine, dimethylphenylphosphine, trimethylphosphite,

triethylphosphite, triisopropylphosphite, ethyl diphenylphosphinite, tributylphosphite, triphenylphosphite, diethylphenylphosphonite, and tribenzylphosphine, 2-cyclohexenone, triphenylphosphine oxide, and mixtures thereof.

5

32. A reactant formulation comprising a polycycloolefin monomer and a Group 10 transition metal procatalyst wherein said polycycloolefin monomer comprises a multifunctional polycycloolefin containing at least two polymerizable norbornene-type moieties.

10

33. The reactant composition of claim 32 wherein said procatalyst is selected from a compound of the formula:



15

wherein M represents a Group 10 transition metal; R' represents an anionic hydrocarbyl ligand; L' represents a Group 15 neutral electron donor ligand; A' is an anionic leaving group; x is 1 or 2.

20

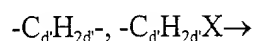
34. The reactant composition of claim 33 wherein M is selected from the group consisting of nickel, palladium, and platinum.

25

35. The reactant composition of claim 33 wherein R' is selected from the group consisting of hydrogen; linear and branched C₁-C₂₀ alkyl; linear and branched C₂-C₂₀ alkenyl; allylic ligands and canonical forms thereof; substituted and unsubstituted C₅-C₁₀ cycloalkyl; substituted and unsubstituted C₆-C₁₅ cycloalkenyl; substituted and unsubstituted C₇-C₃₀ aralkyl; substituted and unsubstituted, C₆-C₃₀ aryl; C₆-C₃₀ heteroatom containing aryl; wherein said heteroatom is selected from the group consisting of sulfur, oxygen, nitrogen, phosphorus,

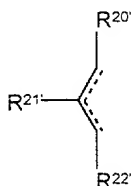
30

wherein the substituents in said substituted radicals are selected from the group consisting of linear or branched C₁-C₅ alkyl, linear or branched C₁-C₅ haloalkyl, linear or branched C₂-C₅ alkenyl, haloalkenyl, halogen, and phenyl optionally substituted with linear or branched C₁-C₅ alkyl, linear or branched C₁-C₅ haloalkyl, and halogen; and a hydrocarbyl containing ligand selected from the formulae:



each of said ligands together with the Group 10 metal form a metallacycle or heteroatom containing metallacycle, wherein d' represents an integer from 3 to 10, and X→ represents an alkenyl or heteroatom containing moiety that coordinates to the Group 10 metal center.

36. The reactant composition of claim 35 wherein said allylic ligand is represented by the formula:

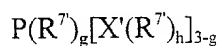


wherein R^{20'}, R^{21'}, and R^{22'} each independently represent hydrogen, halogen, linear and branched C₁-C₅ alkyl, C₅-C₁₀ cycloalkyl, linear and branched C₁-C₅ alkenyl, C₆-C₃₀ aryl, and C₇-C₃₀ aralkyl, each of the foregoing radicals optionally substituted with a substituent selected from linear and branched C₁-C₅ alkyl, linear and branched C₁-C₅ haloalkyl, halogen, and phenyl which can optionally be substituted with linear and branched C₁-C₅ alkyl, linear and branched C₁-C₅ haloalkyl, and halogen; any two of R^{20'}, R^{21'}, and R^{22'} can be linked together with the carbon atoms to which they are attached to form a cyclic or multicyclic ring, each

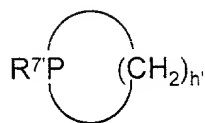
optionally substituted with linear or branched C₁-C₅ alkyl, linear or branched C₁-C₅ haloalkyl, and halogen.

37. The reactant composition of claim 33 wherein said group
15 15 electron donor ligand is selected from the group consisting of amines, pyridines, arsines, stibines and organophosphorus containing compounds.

38. The reactant composition of claim 37 wherein said
organophosphorus containing ligand is selected from a compound of the
10 formula:



wherein X' is oxygen, sulfur, nitrogen, or silicon; g is 0, 1, 2, or 3; h is 1,
15 2, or 3, with the proviso that when X' is a silicon atom, h is 3, when X' is an oxygen or sulfur atom h is 1, and when X' is a nitrogen atom, h is 2; R⁷ is independently selected from hydrogen, linear and branched C₁-C₁₀ alkyl, C₅-C₁₀ cycloalkyl, linear and branched C₁-C₁₀ alkoxy, allyl, linear and branched C₂-C₁₀ alkenyl, C₆-C₁₂ aryl, C₆-C₁₂ aryloxy, C₆-C₁₂ arylsulfides, C₇-C₁₈ aralkyl, cyclic ethers and thioethers, tri(linear and
20 branched C₁-C₁₀ alkyl)silyl, tri(C₆-C₁₂ aryl)silyl, tri(linear and branched C₁-C₁₀ alkoxy)silyl, triaryloxysilyl, tri(linear and branched C₁-C₁₀ alkyl)siloxy, and tri(C₆-C₁₂ aryl)siloxy, wherein each of the foregoing substituents can be optionally substituted with linear or branched C₁-C₅
25 alkyl, linear or branched C₁-C₅ haloalkyl, C₁-C₅ alkoxy, halogen, and combinations thereof; when g is 0 and X' is oxygen, any two or 3 of R⁷ can be taken together with the oxygen atoms to which they are attached to form a cyclic moiety; when g is 3 any two of R⁷ can be taken together with the phosphorus atom to which they are attached to represent a
30 phosphacycle of the formula:



wherein R' is as previously defined and h' is an integer from 4 to 11.

39. The reactant composition of claim 38 wherein g is 3 and R' is independently selected from the group consisting of hydrogen, linear and branched C₁-C₁₀ alkyl, C₅-C₁₀ cycloalkyl, linear and branched C₁-C₁₀ alkoxy, allyl, linear and branched C₂-C₁₀ alkenyl, C₆-C₁₂ aryl, and C₆-C₁₂ aryloxy.

40. The reactant composition of claim 37 wherein said organophosphorus containing ligand is a phosphine selected from the group consisting of trimethylphosphine, triethylphosphine, tri-*n*-propylphosphine, triisopropylphosphine, tri-*n*-butylphosphine, tri-*sec*-butylphosphine, tri-*i*-butylphosphine, tri-*t*-butylphosphine, tricyclopentylphosphine, triallylphosphine, tricyclohexylphosphine, triphenylphosphine, trinaphthylphosphine, tri-*p*-tolylphosphine, tri-*o*-tolylphosphine, tri-*m*-tolylphosphine, tribenzylphosphine, tri(*p*-trifluoromethylphenyl)phosphine, tris(trifluoromethyl)phosphine, tri(*p*-fluorophenyl)phosphine, tri(*p*-trifluoromethylphenyl)phosphine, allyldiphenylphosphine, benzyldiphenylphosphine, bis(2-furyl)phosphine, bis(4-methoxyphenyl)phenylphosphine, bis(4-methylphenyl)phosphine, bis(3,5-bis(trifluoromethyl)phenyl)phosphine, *t*-butylbis(trimethylsilyl)phosphine, *t*-butyldiphenylphosphine, cyclohexyldiphenylphosphine, diallylphenylphosphine, dibenzylphosphine, dibutylphenylphosphine, dibutylphosphine, di-*t*-butylphosphine, dicyclohexylphosphine, diethylphenylphosphine,

di-*i*-butylphosphine, dimethylphenylphosphine,
dimethyl(trimethylsilyl)phosphine, diphenylphosphine,
diphenylpropylphosphine, diphenyl(*p*-tolyl)phosphine,
diphenyl(trimethylsilyl)phosphine, diphenylvinylphosphine,
5 divinylphenylphosphine, ethyldiphenylphosphine,
(2-methoxyphenyl)methylphenylphosphine, tri-*n*-octylphosphine,
tris(3,5-bis(trifluoromethyl)phenyl)phosphine,
tris(3-chlorophenyl)phosphine, tris(4-chlorophenyl)phosphine,
tris(2,6-dimethoxyphenyl)phosphine, tris(3-fluorophenyl)phosphine,
10 tris(2-furyl)phosphine, tris(2-methoxyphenyl)phosphine,
tris(3-methoxyphenyl)phosphine, tris(4-methoxyphenyl)phosphine,
tris(3-methoxypropyl)phosphine, tris(2-thienyl)phosphine,
tris(2,4,6-trimethylphenyl)phosphine, tris(trimethylsilyl)phosphine,
isopropyldiphenylphosphine, dicyclohexylphenylphosphine,
15 (+)-neomenthyldiphenylphosphine, tribenzylphosphine,
diphenyl(2-methoxyphenyl)phosphine,
diphenyl(pentafluorophenyl)phosphine,
bis(pentafluorophenyl)phenylphosphine, and
tris(pentafluorophenyl)phosphine.

20 41. The reactant composition of claim 33 wherein said labile
neutral electron donor ligand is selected from the group consisting of
DMF, DMSO, cyclooctadiene, water, chlorinated alkanes, alcohols,
ethers, ketones, nitriles, arenes, phosphine oxides, organic carbonates and
25 esters.

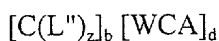
42. The method of claim 33 wherein said anionic leaving
group is selected from the group consisting of halogen, nitrate, triflate,
triflimide trifluoroacetate, tosylate, AlBr_4^- , AlF_4^- , AlCl_4^- , $\text{AlF}_3\text{O}_3\text{SCF}_3^-$,
30 AsCl_6^- , SbCl_6^- , SbF_6^- , PF_6^- , BF_4^- , ClO_4^- , HSO_4^- , carboxylates, acetates,

acetylacetonates, carbonates, aluminates, borates, hydrocarbyl and halogenated hydrocarbyl selected from hydride, linear and branched C₁-C₅ alkyl, linear and branched C₁-C₅ haloalkyl, C₅-C₁₀ cycloalkyl, C₅-C₁₀ cyclohaloalkyl, C₆-C₁₀ aryl, and C₆-C₁₀ haloaryl, wherein said
5 cyclohaloalkyl and haloaryl groups are monosubstituted or multisubstituted with a halogen group selected from bromine, chlorine, fluorine, and iodine.

43. The reactant composition of claim 33 wherein said
10 procatalyst is selected from a compound of group consisting of
bis(triisopropylphosphine)(hydrido)palladium chloride,
bis(triisopropylphosphine)(hydrido)palladium nitrate,
bis(triisopropylphosphine)(hydrido)palladium triflate,
(allyl)palladium(triisopropylphosphine) chloride,
15 (methallyl)palladium(triisopropylphosphine) chloride,
(crotyl)palladium(triisopropylphosphine) chloride,
(allyl)palladium(triisopropylphosphine) trifluoroacetate,
(1,1-dimethyl- π -allyl(triisopropylphosphine)palladium trifluoroacetate,
(2-chloroallyl)palladium(triisopropylphosphine) trifluoroacetate,
20 (allyl)palladium(triisopropylphosphine) triflate,
(crotyl)palladium(triisopropylphosphine) triflate,
(methallyl)palladium(triisopropylphosphine) triflate,
(allyl)palladium(triisopropylphosphine) triflimide,
(methallyl)palladium(triisopropylphosphine) triflimide,
25 bis(tricyclohexylphosphine)(hydrido)palladium chloride,
bis(tricyclohexylphosphine)(hydrido)palladium nitrate,
bis(tricyclohexylphosphine)(hydrido)palladium trifluoroacetate,
bis(tricyclohexylphosphine)(hydrido)palladium formate,
(allyl)palladium(tricyclohexylphosphine) chloride,
30 (methallyl)palladium(tricyclohexylphosphine) chloride,

(allyl)palladium(tricyclohexylphosphine) trifluoroacetate,
 (allyl)palladium(tricyclohexylphosphine) triflate,
 (methallyl)palladium(tricyclohexylphosphine) triflate,
 (crotyl)palladium(tricyclohexylphosphine) triflate,
 5 (methallyl)palladium(tricyclohexylphosphine) triflimide,
 (allyl)palladium(tricyclohexylphosphine) *p*-tolylsulfonate,
 (allyl)palladium(tricyclohexylphosphine) triflimide,
 (allyl)palladium(tricyclopentylphosphine)chloride,
 (methallyl)palladium(tricyclopentylphosphine) chloride,
 10 (allyl)palladium(tricyclopentylphosphine) triflate,
 (crotyl)palladium(tricyclopentylphosphine) triflate,
 (methallyl)palladium(tricyclopentylphosphine) triflate,
 (allyl)palladium(tricyclopentylphosphine) triflimide,
 (methallyl)palladium(tricyclopentylphosphine)triflimide,
 15 (allyl)palladium(triisopropylphosphine)C₆F₅,
 (allyl)palladium(tricyclohexylphosphine)C₆F₅, and
 [(allyl)palladium(HOCH₃)(triisopropylphosphine)][B(O₂-3,4,5,6-Cl₄C₆)₂].

44. A reactant composition comprising a polycycloolefin
 20 monomer wherein said polycycloolefin monomer comprises a
 multifunctional polycycloolefin containing at least two polymerizable
 norbornene-type moieties and an activator salt of the formula:

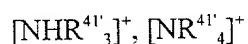


25 wherein C represents a proton, an alkaline earth metal cation, a transition
 metal cation or an organic group containing cation, L'' is a labile neutral
 electron donor ligand, and WCA is a weakly coordinating counteranion,
 z is an integer from 0 to 8, and b and d represent the number of times the
 30 cation complex and weakly coordinating counteranion complex,

respectively, are taken to balance the electronic charge on the overall salt complex.

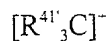
45. The composition of claim 44 wherein said Group I
5 element cation is selected from the group consisting of a proton, lithium, sodium, and potassium; said Group II metal cation is selected from the group consisting of beryllium, magnesium, calcium, strontium, and barium; said transition metal cation is selected from the group consisting of zinc, silver, and thallium; and said organic group cation is selected
10 from ammonium, phosphonium, carbonium and silylium cations.

46. The reactant composition of claim 45 wherein said ammonium cation is selected from a compound of the formulae:



wherein $\text{R}^{41'}$ independently represents a hydrocarbyl, silylhydrocarbyl, or perfluorocarbyl group, each containing 1 to 24 carbon atoms.

47. The reactant composition of claim 45 wherein said carbonium cation is selected from a compound of the formula:

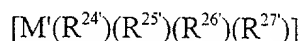


wherein $\text{R}^{41'}$ independently represents a hydrocarbyl, silylhydrocarbyl, or perfluorocarbyl group, each containing 1 to 24 carbon atoms.

48. The reactant composition of claim 44 wherein said weakly coordinating counteranion is selected from the group consisting of

borates, aluminates, boratobenzene anions, carborane anions, and
halocarborane anions.

49. The reactant composition of claim 48 wherein the weakly
5 coordinating anion is a borate or aluminate of the formula:



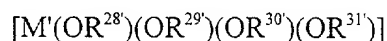
- wherein M' is boron or aluminum and R^{24'}, R^{25'}, R^{26'}, and R^{27'}
10 independently represent fluorine, linear and branched C₁-C₁₀ alkyl, linear
and branched C₁-C₁₀ alkoxy, linear and branched C₃-C₅ haloalkenyl, linear
and branched C₃-C₁₂ trialkylsiloxy, C₁₈-C₃₆ triarylsiloxy, substituted and
unsubstituted C₆-C₃₀ aryl, and substituted and unsubstituted C₆-C₃₀
aryloxy groups, wherein R^{24'} to R^{27'} can not simultaneously represent
15 alkoxy or simultaneously represent aryloxy, and wherein said aryl and
aryloxy groups when substituted are monosubstituted or multisubstituted
and said substituents are independently selected from linear and branched
C₁-C₅ alkyl, linear and branched C₁-C₅ haloalkyl, linear and branched
C₁-C₅ alkoxy, linear and branched C₁-C₅ haloalkoxy, linear and branched
20 C₁-C₁₂ trialkylsilyl, C₆-C₁₈ triarylsilyl, and halogen selected from chlorine,
bromine, and fluorine.

50. The reactant composition of claim 49 wherein said borate
is selected from the group consisting of tetrakis(pentafluorophenyl)borate,
25 tetrakis(3,5-bis(trifluoromethyl)phenyl)borate,
tetrakis(2-fluorophenyl)borate, tetrakis(3-fluorophenyl)borate,
tetrakis(4-fluorophenyl)borate, tetrakis(3,5-difluorophenyl)borate,
tetrakis(2,3,4,5-tetrafluorophenyl)borate,
tetrakis(3,4,5,6-tetrafluorophenyl)borate,
30 tetrakis(3,4,5-trifluorophenyl)borate, methyltris(perfluorophenyl)borate,

ethyltris(perfluorophenyl)borate, phenyltris(perfluorophenyl)borate,
tetrakis(1,2,2-trifluoroethylenyl)borate,
tetrakis(4-tri-*i*-propylsilyltetrafluorophenyl)borate,
tetrakis(4-dimethyl-*tert*-butylsilyltetrafluorophenyl)borate,
5 (triphenylsiloxy)tris(pentafluorophenyl)borate,
(octyloxy)tris(pentafluorophenyl)borate, tetrakis[3,5-bis[1-methoxy-2,2,2-
trifluoro-1-(trifluoromethyl)ethyl]phenyl]borate,
tetrakis[3-[1-methoxy-2,2,2-trifluoro-1-(trifluoromethyl)ethyl]-5-
(trifluoromethyl)phenyl]borate, and tetrakis[3-[2,2,2-trifluoro-1-(2,2,2-
10 trifluoroethoxy)-1-(trifluoromethyl)ethyl]-5-
(trifluoromethyl)phenyl]borate.

51. The reactant composition of claim 49 wherein said
aluminate is selected from the group consisting of
15 tetrakis(pentafluorophenyl)aluminate,
tris(nonafluorobiphenyl)fluoroaluminate,
(octyloxy)tris(pentafluorophenyl)aluminate,
tetrakis(3,5-bis(trifluoromethyl)phenyl)aluminate, and
methyltris(pentafluorophenyl)aluminate.

52. The reactant composition of claim 48 wherein the weakly
coordinating anion is a borate or aluminate of the formula:



25 M' is boron or aluminum, R²⁸, R²⁹, R³⁰, and R³¹ independently represent
linear and branched C₁-C₁₀ alkyl, linear and branched C₁-C₁₀ haloalkyl,
C₂-C₁₀ haloalkenyl, substituted and unsubstituted C₆-C₃₀ aryl, and
substituted and unsubstituted C₇-C₃₀ aralkyl groups, subject to the proviso
30 that at least three of R²⁸ to R³¹ must contain a halogen containing

substituent; OR^{28'} and OR^{29'} can be taken together to form a chelating substituent represented by -O-R^{32'}-O-, wherein the oxygen atoms are bonded to M' and R^{32'} is a divalent radical selected from substituted and unsubstituted C₆-C₃₀ aryl and substituted and unsubstituted C₇-C₃₀ aralkyl, wherein said aryl and aralkyl groups when substituted are monosubstituted or multisubstituted and said substituents are independently selected from linear and branched C₁-C₅ alkyl, linear and branched C₁-C₅ haloalkyl, linear and branched C₁-C₅ alkoxy, linear and branched C₁-C₅ haloalkoxy, linear and branched C₁-C₁₂ trialkylsilyl, C₆-C₁₈ triarylsilyl, and halogen selected from chlorine, bromine, and fluorine.

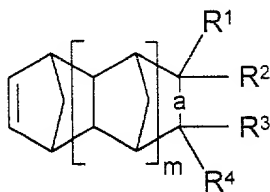
53. The reactant composition of claim 52 wherein said borate is selected from the group consisting of [B(O₂C₆F₄)₂]⁻, [B(OC(CF₃)₂(CH₃))₄]⁻, [B(OC(CF₃)₂H)₄]⁻, [B(OC(CF₃)(CH₃)H)₄]⁻, and [B(OCH₂(CF₃))₄]⁻.

54 The reactant composition of claim 52 wherein said aluminate is selected from the group consisting of, [Al(OC(CF₃)₂Ph)₄]⁻, [Al(OC(CF₃)₂C₆H₄-4-CH₃)₄]⁻, [Al(OC(CF₃)₃)₄]⁻, [Al(OC(CF₃)(CH₃)H)₄]⁻, [Al(OC(CF₃)₂H)₄]⁻, [Al(OC(CF₃)₂C₆H₄-4-*i*-Pr)₄]⁻, [Al(OC(CF₃)₂C₆H₄-4-*t*-butyl)₄]⁻, [Al(OC(CF₃)₂C₆H₄-4-SiMe₃)₄]⁻, [Al(OC(CF₃)₂C₆H₄-4-Si-*i*-Pr)₄]⁻, [Al(OC(CF₃)₂C₆H₂-2,6-(CF₃)₂-4-Si-*i*-Pr)₄]⁻, [Al(OC(CF₃)₂C₆H₃-3,5-(CF₃)₂)₄]⁻, [Al(OC(CF₃)₂C₆H₂-2,4,6-(CF₃)₃)₄]⁻, and [Al(OC(CF₃)₂C₆F₅)₄]⁻.

55. The reactant composition of claim 44 wherein said activator salt is selected from the group consisting of lithium tetrakis(pentafluorophenyl)borate, sodium tetrakis(pentafluorophenyl)borate, lithium(diethyl ether) tetrakis(pentafluorophenyl)borate,

lithium(diethyl ether)₂, tetrakis(pentafluorophenyl)borate,
 lithium tris(isopropanol) tetrakis(pentafluorophenyl)borate,
 lithium tetrakis(methanol) tetrakis(pentafluorophenyl)borate, silver
 tetrakis(pentafluorophenyl)borate, tris(toluene)silver
 5 tetrakis(pentafluorophenyl)borate, trityl tetrakis(pentafluorophenyl)borate,
 N,N-dimethylanilinium tetrakis(pentafluorophenyl)borate,
 lithium tetrakis(3,5-bis(trifluoromethyl)phenyl)borate,
 sodium tetrakis(3,5-bis(trifluoromethyl)phenyl)borate,
 N,N-dimethylanilinium tetrakis[3,5-bis(trifluoromethyl)phenyl]borate,
 10 silver tetrakis[3,5-bis(trifluoromethyl)phenyl]borate,
 tris(toluene)silver tetrakis[3,5-bis(trifluoromethyl)phenyl]borate,
 thallium tetrakis[3,5-bis(trifluoromethyl)phenyl]borate, LiB(O₂C₆F₄)₂,
 LiB(OC(CH₃)(CF₃)₂)₄, LiAl(OC(CF₃)₂Ph)₄, LiAl(OC(CF₃)₂C₆H₄CH₃)₄,
 LiAl(OC(CH₃)(CF₃)₂)₄, LiAl(OC(CF₃)₃)₄, LiAl(OC(CF₃)₂C₆H₄-4-*i*-Pr)₄,
 15 LiAl(OC(CF₃)₂C₆H₃-3,5-(CF₃)₂)₄, LiAl(OC(CF₃)₂C₆H₂-2,4,6-(CF₃)₃)₄, and
 LiAl(OC(CF₃)₂C₆F₅)₄.

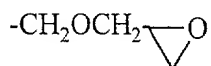
56. The reactant composition claim 32, 33, 43, 44, 48, or 55
 wherein said polycycloolefin comprises a monomer selected from a
 20 compound of the formula:



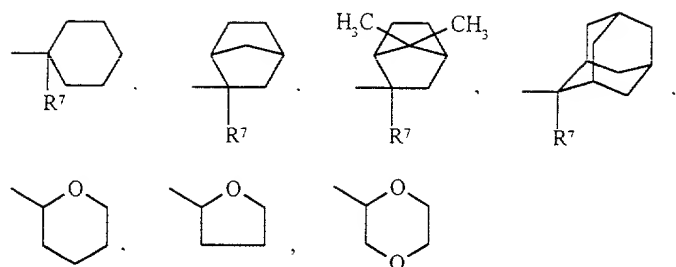
wherein "a" represents a single or double bond; m is an integer from 0 to
 5; when "a" is a double bond one of R¹, R² and one of R³, R⁴ is not
 25 present; and R¹ to R⁴ independently represent hydrogen, substituted and
 unsubstituted linear and branched C₁-C₁₀ alkyl, linear and branched C₁-C₁₀

haloalkyl, substituted and unsubstituted linear and branched C₂-C₁₀ alkenyl, linear and branched C₂-C₁₀ haloalkenyl, substituted and unsubstituted linear and branched C₂-C₁₀ alkynyl, substituted and unsubstituted C₄-C₁₂ cycloalkyl, substituted and unsubstituted C₄-C₁₂ halocycloalkyl, substituted and unsubstituted C₄-C₁₂ cycloalkenyl, substituted and unsubstituted C₄-C₁₂ halocycloalkenyl, substituted and unsubstituted C₆-C₁₂ aryl, substituted and unsubstituted C₆-C₁₂ haloaryl and substituted and unsubstituted C₇-C₂₄ aralkyl, R¹ and R² or R³ and R⁴ can be taken together to represent a C₁-C₁₀ alkylidenyl group,

-(CH₂)_nC(O)NH₂, -(CH₂)_nC(O)Cl, -(CH₂)_nC(O)OR⁵, -(CH₂)_n-OR⁵, -(CH₂)_nOC(O)R⁵, -(CH₂)_n-C(O)R⁵, -(CH₂)_n-OC(O)OR⁵, -(CH₂)_nSiR⁵, -(CH₂)_nSi(OR⁵)₃, -(CH₂)_nC(O)OR⁶, and the group:

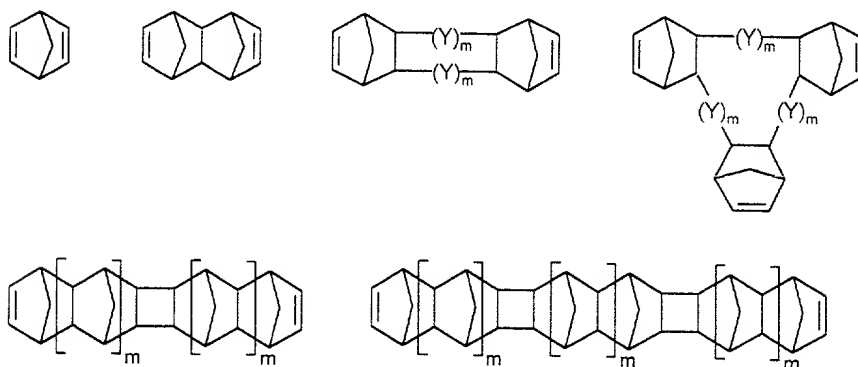


wherein n independently represents an integer from 0 to 10 and R⁵ independently represents hydrogen, linear and branched C₁-C₁₀ alkyl, linear and branched, C₂-C₁₀ alkenyl, linear and branched C₂-C₁₀ alkynyl, C₅-C₁₂ cycloalkyl, C₆-C₁₄ aryl, and C₇-C₂₄ aralkyl; R⁶ represents a radical selected from -C(CH₃)₃, -Si(CH₃)₃, -CH(R⁷)OCH₂CH₃, -CH(R⁷)OC(CH₃)₃, dicyclopropylmethyl, dimethylcyclopropylmethyl, or the following cyclic groups:



wherein R^7 represents hydrogen or a linear or branched (C_1 - C_5) alkyl group; R^1 and R^4 together with the two ring carbon atoms to which they are attached can represent a substituted or unsubstituted cycloaliphatic group containing 4 to 30 ring carbon atoms, a substituted or unsubstituted aryl group containing 6 to 18 ring carbon atoms and combinations thereof; R^1 and R^4 can be taken together to form the divalent bridging group, -C(O)-Q-(O)C-, which when taken together with the two ring carbon atoms to which they are attached form a pentacyclic ring, wherein Q represents an oxygen atom or the group N(R^8), wherein R^8 is selected from hydrogen, halogen, linear and branched C_1 - C_{10} alkyl, and C_6 - C_{18} aryl.

57. The reactant composition of claim 55 wherein said multifunctional polycycloolefin monomer includes a monomer selected from a compound of the formula:



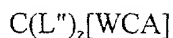
and mixtures thereof, wherein Y represents a (-CH₂-) group and m independently represents an integer from 0 to 5, and when m is 0, Y represents a single bond.

5 58. The reactant composition of claim or 56 wherein said multifunctional polycycloolefin monomer is present in a range from 0.25 to 99.75 mole % of the total polycycloolefin monomer composition.

10 59. The reactant composition of claim 32, 33, 43, 44, 48, 55 or 56 wherein said composition further comprises a rate moderator selected from the group consisting of water, tetrahydrofuran, 2-methyltetrahydrofuran, diethyl ether, methyl-*tert*-butyl ether, dimethoxyethane, diglyme, trimethylphosphine, triethylphosphine, tributylphosphine, tri(ortho-tolyl)phosphine, tri-*tert*-butylphosphine, 15 tricyclopentylphosphine, tricyclohexylphosphine, triisopropylphosphine, trioctylphosphine, triphenylphosphine, tri(pentafluorophenyl)phosphine, methyldiphenylphosphine, dimethyldiphenylphosphine, trimethylphosphite, triethylphosphite, triisopropylphosphite, ethyl diphenylphosphinite, tributylphosphite, triphenylphosphite, diethyldiphenylphosphonite, and 20 tribenzylphosphine, 2-cyclohexenone, triphenylphosphine oxide, and mixtures thereof.

 60. A salt composition comprising a compound of the formula:

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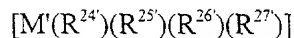
 wherein C is lithium or sodium, L'' is an alcohol and z is an integer between 2 and 8 inclusive, and WCA is a weakly coordinating 30 counteranion.

61. The salt composition of claim 58 wherein said alcohol is represented by the formula R^9OH , wherein R^9 represents linear and branched C_1-C_{20} alkyl, linear and branched C_1-C_{20} haloalkyl, substituted and unsubstituted C_3-C_{20} cycloalkyl, substituted and unsubstituted C_6-C_{18} aryl, substituted and unsubstituted C_6-C_{18} aralkyl, and substituted and unsubstituted norbornenyl wherein said substituents in said substituted groups are independently selected from linear and branched C_1-C_{12} alkyl, linear and branched C_1-C_5 haloalkyl, linear and branched C_1-C_5 alkoxy, C_6-C_{12} aryl, and halogen selected from chlorine, bromine, and fluorine.

62. The salt composition of claim 59 wherein said alcohol is selected from methanol, ethanol, n-propanol, isopropanol, *t*-butanol, and 5-norbornene-2-methanol.

63. The salt composition of claim 58 wherein said weakly coordinating counteranion is selected from borate or aluminate.

64. The salt composition of claim 61 wherein the weakly coordinating anion is a borate or aluminate of the formula:



wherein M' is boron or aluminum and $R^{24'}$, $R^{25'}$, $R^{26'}$, and $R^{27'}$ independently represent fluorine, linear and branched C_1-C_{10} alkyl, linear and branched C_1-C_{10} alkoxy, linear and branched C_3-C_5 haloalkenyl, linear and branched C_3-C_{12} trialkylsiloxy, $C_{18}-C_{36}$ triarylsiloxy, substituted and unsubstituted C_6-C_{30} aryl, and substituted and unsubstituted C_6-C_{30} aryloxy groups, wherein $R^{24'}$ to $R^{27'}$ can not simultaneously represent alkoxy or simultaneously represent aryloxy, and wherein said aryl and

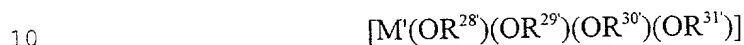
aryloxy groups when substituted are monosubstituted or multisubstituted and said substituents are independently selected from linear and branched C₁-C₅ alkyl, linear and branched C₁-C₅ haloalkyl, linear and branched C₁-C₅ alkoxy, linear and branched C₁-C₅ haloalkoxy, linear and branched C₁-C₁₂ trialkylsilyl, C₆-C₁₈ triarylsilyl, and halogen selected from chlorine, bromine, and fluorine.

65. The salt composition of claim 62 wherein said borate is selected from the group consisting of tetrakis(pentafluorophenyl)borate, tetrakis(3,5-bis(trifluoromethyl)phenyl)borate, tetrakis(2-fluorophenyl)borate, tetrakis(3-fluorophenyl)borate, tetrakis(4-fluorophenyl)borate, tetrakis(3,5-difluorophenyl)borate, tetrakis(2,3,4,5-tetrafluorophenyl)borate, tetrakis(3,4,5,6-tetrafluorophenyl)borate, tetrakis(3,4,5-trifluorophenyl)borate, methyltris(perfluorophenyl)borate, ethyltris(perfluorophenyl)borate, phenyltris(perfluorophenyl)borate, tetrakis(1,2,2-trifluoroethylenyl)borate, tetrakis(4-tri-*i*-propylsilyltetrafluorophenyl)borate, tetrakis(4-dimethyl-*tert*-butylsilyltetrafluorophenyl)borate, (triphenylsiloxy)tris(pentafluorophenyl)borate, (octyloxy)tris(pentafluorophenyl)borate, tetrakis[3,5-bis[1-methoxy-2,2,2-trifluoro-1-(trifluoromethyl)ethyl]phenyl]borate, tetrakis[3-[1-methoxy-2,2,2-trifluoro-1-(trifluoromethyl)ethyl]-5-(trifluoromethyl)phenyl]borate, and tetrakis[3-[2,2,2-trifluoro-1-(2,2,2-trifluoroethoxy)-1-(trifluoromethyl)ethyl]-5-(trifluoromethyl)phenyl]borate.

66. The salt composition of claim 62 wherein said aluminate is selected from the group consisting of

tetrakis(pentafluorophenyl)aluminate,
tris(nonafluorobiphenyl)fluoroaluminate,
(octyloxy)tris(pentafluorophenyl)aluminate,
tetrakis(3,5-bis(trifluoromethyl)phenyl)aluminate, and
5 methyltris(pentafluorophenyl)aluminate.

67. The salt composition of claim 61 wherein the weakly coordinating anion is a borate or aluminate of the formula:



M' is boron or aluminum, R²⁸, R²⁹, R³⁰, and R³¹ independently represent linear and branched C₁-C₁₀ alkyl, linear and branched C₁-C₁₀ haloalkyl, C₂-C₁₀ haloalkenyl, substituted and unsubstituted C₆-C₃₀ aryl, and
15 substituted and unsubstituted C₇-C₃₀ aralkyl groups, subject to the proviso that at least three of R²⁸ to R³¹ must contain a halogen containing substituent; OR²⁸ and OR²⁹ can be taken together to form a chelating substituent represented by -O-R³²-O-, wherein the oxygen atoms are bonded to M' and R³² is a divalent radical selected from substituted and
20 unsubstituted C₆-C₃₀ aryl and substituted and unsubstituted C₇-C₃₀ aralkyl, wherein said aryl and aralkyl groups when substituted are monosubstituted or multisubstituted and said substituents are independently selected from linear and branched C₁-C₅ alkyl, linear and branched C₁-C₅ haloalkyl, linear and branched C₁-C₅ alkoxy, linear and
25 branched C₁-C₅ haloalkoxy, linear and branched C₁-C₁₂ trialkylsilyl, C₆-C₁₈ triarylsilyl, and halogen selected from chlorine, bromine, and fluorine.

68. The salt composition of claim 65 wherein said borate is
30 selected from the group consisting of [B(O₂C₆F₄)₂]⁻,

$[B(OC(CF_3)_2(CH_3))_4]^-$, $[B(OC(CF_3)_2H)_4]^-$, $[B(OC(CF_3)(CH_3)H)_4]^-$, and $[B(OCH_2(CF_3))_4]^-$.

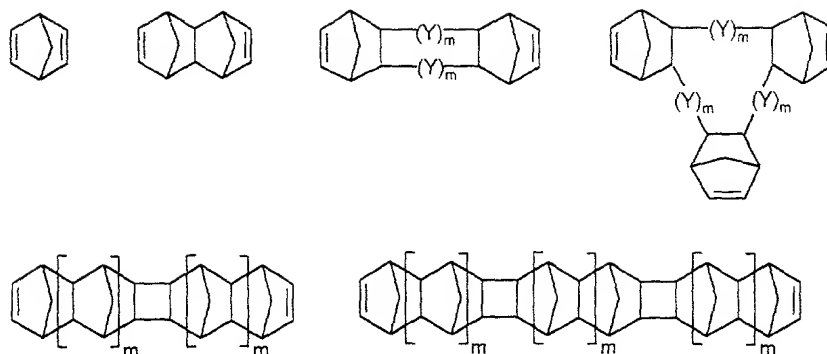
69 The salt composition of claim 65 wherein said aluminate is
5 selected from the group consisting of, $[Al(OC(CF_3)_2Ph)_4]^-$,
 $[Al(OC(CF_3)_2C_6H_4-4-CH_3)_4]^-$, $[Al(OC(CF_3)_3)_4]^-$, $[Al(OC(CF_3)(CH_3)H)_4]^-$,
 $[Al(OC(CF_3)_2H)_4]^-$, $[Al(OC(CF_3)_2C_6H_4-4-i-Pr)_4]^-$, $[Al(OC(CF_3)_2C_6H_4-4-t-$
butyl) $_4]^-$, $[Al(OC(CF_3)_2C_6H_4-4-SiMe_3)_4]^-$, $[Al(OC(CF_3)_2C_6H_4-4-Si-i-Pr_3)_4]^-$,
 $[Al(OC(CF_3)_2C_6H_2-2,6-(CF_3)_2-4-Si-i-Pr_3)_4]^-$, $[Al(OC(CF_3)_2C_6H_3-3,5-$
10 $(CF_3)_2)_4]^-$, $[Al(OC(CF_3)_2C_6H_2-2,4,6-(CF_3)_3)_4]^-$, and $[Al(OC(CF_3)_2C_6F_5)_4]^-$.

70. The salt composition of claim 58 selected from the group
consisting of lithium tris(isopropanol) tetrakis(pentafluorophenyl)borate,
and lithium tetrakis(methanol) tetrakis(pentafluorophenyl)borate.

71. A crosslinked addition polymer polymerized from a
monomer mixture comprising a polycycloolefin containing one
polymerizable norbornene-type moiety and a multifunctional
polycycloolefin containing at least two polymerizable norbornene-type
20 moieties.

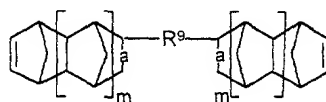
72. The crosslinked addition polymer of claim 69 wherein said
monomer mixture comprises from 0.25 to 99.75 mole % of a
multifunctional polycycloolefin monomer.

73. The crosslinked addition polymer of claim 69 wherein
multifunctional polycycloolefin monomer includes a monomer selected
from a compound of the formula:



and mixtures thereof, wherein Y represents a $(-\text{CH}_2-)$ group and m independently represents an integer from 0 to 5, and when m is 0, Y represents a single bond.

74. The multifunctional polycycloolefin monomer set forth in claims 29, 55, and 69 wherein said monomer is selected from a composition of the formula:



wherein "a" independently represents a single or double bond, m independently is an integer from 0 to 5, R^9 is a divalent radical selected from divalent hydrocarbyl radicals and divalent ether radicals.

75. The multifunctional polycycloolefin monomer of claim 72 wherein said hydrocarbyl radical is selected from $\text{C}_1 - \text{C}_{10}$ alkylene radicals and divalent aromatic radicals.

5

77. The multifunctional polycycloolefin monomer of claim 74 wherein R¹⁰ independently is selected from the group consisting of C₁-C₁₀ alkylene, divalent aromatic radicals, and combinations thereof.